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THE PROCEEDINGS OF THE ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

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NOTES ON A DESERT GRASSHOPPER WITH DIGGING HABITS, *EREMOGRYLLUS HAMMADAE* KRAUSS 1902 (ORTHOPTERA, ACRIDIDAE)

By B. P. Uvarov, D.Sc., F.R.E.S.

(*British Museum (Natural History).*)

and

M. A. Volkonsky.

(*Institut Pasteur, Algiers.*)

Eremogryllus hammadae Kr. is a small grasshopper hitherto known from only a few localities of northern Sahara, and its habits, ecology and distribution have remained very little known. The present paper is based on observations made by M. A. and M. T. Volkonsky on a Mission from the Institut Pasteur of Algiers in April 1938. This Mission explored the Ougarta region south of Beni-Abbes, and then crossed the western part of the Great Western Erg from Beni-Abbes to Beni-Ounif.

The main part of the paper, consisting of field observations on *Eremogryllus*, is by M. A. Volkonsky, while the notes on synonymy, distribution and morphological adaptations are by B. P. Uvarov.

The species has been found in southern Algeria and in Tunis by Krauss, and he gave its description (1902, *Verh. zool.-bot. Ges. Wien.* **52** : 238–240, figs. 4–6); since then it has been recorded only twice, by Vosseler from Tunis (1902, *Zool. Jahrb.* (Syst.) **16** : 355) and by Uvarov from southern Algeria (1923, *Novit. Zool.* **30** : 64). In 1932, however, Werner described from Tendrara and Azrou in Morocco a *Leptopternis quadriocellata* (*Sitz.-Ber. Akad. Wiss. Wien*, (Mat.-Nat.), **141** : 146, fig. 10) which Uvarov (1934, *Ann. Mag. nat. Hist.* (10) **14** : 473) referred to the genus *Eremogryllus* without recognising its identity with Krauss's species. The good series of specimens collected by Volkonsky now makes it possible to establish the following synonymy : *Eremogryllus hammadae* Krauss 1902 = *Leptopternis quadriocellata* Werner 1932 (**syn. nov.**). The reason which induced Uvarov at first to regard the two insects as distinct was the presence in *quadriocellata* of fairly well-marked pronotal carinae, often marked with white spots, but this character is subject to individual variations, as may be seen in the series now available.

Eremogryllus hammadae is called by Arabs *bou ser-ser* (" father stridulator "), and it is probably the only Acridid whose stridulation may be heard in spring in the north-western Sahara. The localities where it is common and where the air is filled with its song, form a strong contrast with the rest of the desert, almost silent at that season.

Eremogryllus was observed by the Institut Pasteur Mission between the 6th and 18th April only on the route from Beni-Abbes to Beni-Ounif along the northern edge of the Grand Erg, between Hassi-Ouskir and Oued en-Namous (at el-Khebour, Guern Chaib, Tamzaia and M'Hardhi), on limestone soil, partly covered by sand. The landscape here is formed of the following main elements : *reg*, or a plain covered by small pebbles and gravel; *fedj*, or a *reg* where pebbles

are mixed with sand so that it becomes difficult to negotiate a car, and *arish*, or limestone hills, some of which form the bases of sand dunes. The country appears either as a plain cut up by a network of deep ravines (*e.g.* at M'Hardhi and Tamzaia), or as a system of low hills (at Guern Chaib and el-Khebour), depending on the degree of development of the old (geological) river beds. Everywhere are scattered small, 2–5 metres high, mobile dunes, of yellowish-white sand (see fig. 1). Similar landscape extends farther to the north-east, into the el-Hobeur area.

The vegetation is of transitional type and consists of sparse xerophilous shrubs belonging both to the flora of the *erg*, or sand-hills (*e.g. Retama raetam, Calligonum comosum, Cornulaca monacantha*), and to that of the stony *reg* (*Salsola vermiculata, Limoniastrum feei*). The following are, however, particularly characteristic for this area : *Helianthemum brachypodum, Haloxylon scoparium* and *Henophyton deserti* (*Oudneya africana*). In addition, the whole area, owing to good rains in October 1937, was abundantly covered by flowering seasonal ephemeres (" *asheb* " in Arabic), such as *Danthonia forskahlii, Aristida plumosa, Asphodelus tenuifolius, Erodium glaucophyllum, Monsonia nivea, Helianthemum Lippii, Savignya longistyla, Tourneuxia variifolia, Plantago albicans*, which in places formed almost a steppe-like, though sparse, cover.

The Acridid fauna of this area is also of a transitional character, since side by side with the typical inhabitants of the *erg* (such as *Hyalorrhipis canescens* Sauss.) there occur saxicolous species (*Sphingonotus rubescens* Wlk., *Tmethis cisti* F.).

Fig. 1.—Diagram of habitats of *Eremogryllus hammadae* Kr. Arrows indicate where the grasshoppers were found. Sandy areas shaded. Letters denote plants, as follows : As—*Asphodelus tenuifolius*, Cr—*Cornulaca monacantha*, Ha—*Helianthemum brachypodium*, Hp—*Henophyton deserti*, Hx—*Haloxylon scoparium*, R—*Retama raetam*, S—*Salsola vermiculata* (small seasonal herbs not shown).

During the visit of the Mission most of the *Eremogryllus* were adult, and one case of copulation was observed, but there still occurred some larvae of the later instars. *Eremogryllus* in the M'Hardhi plain was particularly numerous where the ephemerous vegetation was most varied. Here this species constituted the bulk of the Acridid population, and during the warm hours of the day one could continually hear the song of 2–3 males at the same time.

Eremogryllus definitely prefers places covered by sand (at least one centimetre deep) at the base of little sand-hillocks, or on the *fedj*, in the sand between pebbles. Here it may be seen moving by rapid zigzag flights for 4–5 metres, or by short frequent jumps. A stop is almost immediately followed by " digging-in." To do this, the grasshopper stands on its first two pairs of legs, while the posterior legs are jerked alternately backwards, throwing the sand from under the abdomen (see fig. 2, C). The insect also moves forward and backward, thus enlarging the depression made in the sand. Soon the depression becomes so deep that the dorsum of the grasshopper is lower than the level of the surrounding sand. In this position *Eremogryllus* is sheltered from wind,

and males, in the warm part of the day, usually commence to stridulate, crouching in the depression. Females, however, continue the process by covering themselves by sand. For this purpose, a female uses mainly the second pair of legs which, in this species, are exceptionally long. By moving these legs backwards and forwards the female sweeps sand on to her body (fig. 2, D), while the anterior legs help to cover the head. Finally, only the vertex, eyes and antennae remain visible above the sand (fig. 2, E). The whole process of "digging-in" takes less than a minute. It appears that males, when the weather is not favourable for stridulation, cover themselves as completely as

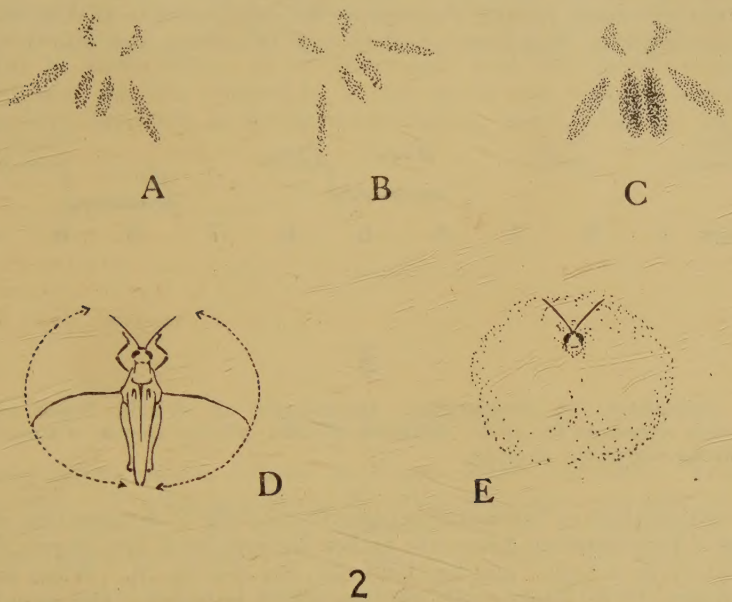

FIG. 2.—A & B. Footprints of *Eremogryllus* on sand—made when jumping; C, footprints after an attempt at digging; D, diagram of sweeping movements of middle legs; E, a female covered up by sand.

females. When covered by sand, *Eremogryllus* is not disturbed by a stick moved over its head as close as one centimetre, but if touched, it flies up from the sand at once.

The selection of habitat by *Eremogryllus* must be dependent on the habits just described. In a pure stony desert (*hammada*) it would be unable to dig itself in, while the sand of the great dunes of the *erg* (50–200 metres high) consists of reddish very coarse grains and is probably unsuitable for the purpose. It must be due to the same reason that *Eremogryllus* is not found on the bare places in the middle of the *erg* where coarse sand is sharply delimited from the pebbly *reg*. All habitats of *Eremogryllus* observed were in the area with patches of fine whitish wind-blown sand.

These observations suggest that Krauss (*loc. cit.*) has probably also observed *Eremogryllus* not on the pure *hammada* but in places where some patches of blown sand occurred. Therefore, the specific name appears somewhat misleading.

The digging habits of *Eremogryllus* are of special interest, in the first instance

because so far it has been only briefly recorded that *Acrotylus insubricus* Scop. (Nikolsky, 1928, *in* Uvarov : *Locusts and Grasshoppers* : 63) and *A. crassus* St. and *A. deustus* Thnbg. (Key, 1930, *S. Afr. J. Sci.* **27** : 410) can bury themselves in sand, but details of the process remained undescribed.

Secondly, the observations on *Eremogryllus* throw some light on the ecological significance of the specialised posterior tibial spurs and of the extremely elongated middle legs in a number of arenicolous ACRIDIDAE. These characters are found in all members of the genera *Hyalorrhipis* and *Tenuitarsus*, as well as in some *Acrotylus*, and they suggest that the digging habit may be much more common in arenicolous ACRIDIDAE than is at present known. Since these genera are not closely related, *Tenuitarsus* belonging even to another subfamily (PYRGOMORPHINAE), this is an excellent case of convergence due to identical habitat.

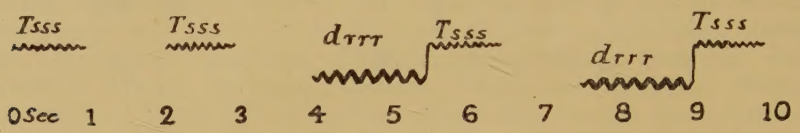

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FIG. 3.—Stridulation of *Eremogryllus*. Abscissa-time in seconds, height above the abscissa represents the pitch; thickness of lines—relative volume of sound; length of waves—frequency of beats.

The stridulation of *Eremogryllus* (described briefly by Krauss, *tom. cit.* : 240) consists of two vibrating notes, one rather low and loud, *drrr* or *grrr*, followed immediately by a higher and less loud one, *tsss* (see fig. 3). When beginning to stridulate, or in danger, only the *tsss* sound is heard. The sound *drrr* is accompanied by strong and wide vibration of half-opened elytra and wings. Volkonsky was unable to observe the stridulation sufficiently closely to be able to say whether the sound is produced by the rubbing of elytra against each other, or by rubbing the femur against elytron (as stated by Krauss). When the sound *tsss* is produced, the elytra are less open and their vibrations less extensive. Stridulation usually commenced about 9.30 a.m. and ended shortly before sunset. No direct observations on the temperature conditions of stridulation were made, but from the records taken three times a day in the shade of a tent it would appear that the lower limit of stridulation is about 21–23° C. Strong wind, blowing sand about, and causing a haze, did not interfere with stridulation.

The known distribution of *Eremogryllus* may be summarised, as follows.

S.E. MOROCCO : Tendrara, north-west of Figuig (Werner, 1932, *tom. cit.*); Ouihalane (Uvarov, 1934, *tom. cit.*).

S. ALGERIA : between Ouargla and Ghardaja (Krauss, 1902, *tom. cit.*); between Oued Mzab and Oued Nsa (Krauss, 1902, *tom. cit.*); El Mreir (Finot, 1895, *Ann. Soc. ent. Fr.* **1895** : 463; under the name *Leptoscirtus aviculus*, but the specimens were examined by Uvarov and found to belong to *E. hammadae*; see also Vosseler, *tom. cit.*, who recorded specimens from the same locality sent him by Brunner, and belonging to the same series as those in the Finot collection); Ain Sefra (Uvarov, 1923, *tom. cit.*); el-Khebour, Guera Chaib, Tamzaia

and M'Hardhi on the northern edge of the Great Western Erg (Volkonsky, see above).

TUNIS : sand-dunes south of Gafsa (Vosseler, *tom. cit.*).

TRIPOLITANIA : Sofeddin (Voyage Menier et Mathuissieux), a female in the Finot collection in Paris under the name *Leptoscirtus aviculus*, examined by Uvarov.

It may be seen that all these records are compatible with the ecology of *E. hammadae* as observed by Volkonsky and the species must be restricted to the *reg* and *hammada* areas of Sahara, where there is some wind-blown sand. It is, therefore, quite certain that Werner's record (*tom. cit.*) of his *Leptopternis quadriocellata* from Azrou in the Middle Atlas of Morocco at an altitude of 1200 metres in the zone of cedar forests should be regarded as erroneous, and probably due to mislabelling. It is unfortunate that the specimen with this particular label has been selected by Werner as the type, since he had another specimen from Tendrara, in the Moroccan Sahara, where, probably, both were collected.

BOOK NOTICE.

Belauschtes Leben. Kleine Kreatur in Wasser, Busch und Halm. Von K. O. BARTELS. 164 Photographische Naturbeobachtungen aus dem Leben der niederen Tierwelt. Mit einem Geleitwort von Dr. P. DEEGENER. [n.d.] Berlin (Hugo Bermühler Verlag). pp. xii + 182. Price Rmk. 4.80.

This book is a collection of original photographs, taken from life, of Invertebrate animals.

By far the larger part of the book concerns insects (pp. 36–120, 139–179).

Pages 1–120 give the illustrations, and the remainder of the book is the explanation thereto.

For each illustration full details of the subject are given and to these is added the month when the photograph was taken.

The Insects illustrated are not restricted to the common species, although these are not neglected, and the orders Odonata, Orthoptera, Rhynchota, Neuroptera, Diptera, Hymenoptera, Coleoptera and Lepidoptera are all well represented.

Of the 164 pictures only 30 have previously been published.

The species depicted are of Palaearctic distribution.

A PHASMID WITH SPERMATOPHORE

By W. P. Le Feuvre, M.R.C.S., L.R.C.P.

Communicated by Dr. B. P. Uvarov, F.R.E.S.

There are two species of Phasmidae to be found in and about Cape Town : *Phalces longiscaphum* de Haan, and *Macynia labiata* Thunb. Of these the first is by far the commoner but has a characteristic only once recorded, as far as I know, in the case of other Stick-insects (Chopard, 1938, *Encycl. Ent.* **20** : 164), although occurring among other families of Orthoptera and Neuroptera. The peculiarity consists of the fertilisation of the eggs by means of a spermatophore. This little organ is glistening white in colour, globular in form and measures a millimetre in diameter. It is transferred from the male to the female almost immediately after the orgasm occurs during coitus.

The globe takes about half a minute to fill and the spermatozoa gradually spread themselves over the genitalia of the female. As the sac empties itself, its colour changes from white to a pale green. Both its appearance and disappearance are very variable in point of time. So indeed is the time expended in the whole of the sexual activities, which may be spread over two hours and upwards. When the act is completed it is not uncommon for the male to attach himself by his claspers to the 6th abdominal segment of the female and remain in that position for several days. On several occasions I have been the witness of attacks made by the so-called " Argentine Ant " on the spermatophore. In one particular case, in spite of vigorous kicks on the part of both male and female Phasmid, the ant succeeded in cutting through the strands by which the little globe is attached to one or other of the Phasmids and carrying it off in triumph to its nest.

The antennae often play a conspicuous part in the proceedings. At the time of the appearance of the spermatophore the male may slightly alter his position so as to approximate his antennae to those of the female, at the same time causing them to vibrate rapidly. She may respond in like manner or, on the other hand, may preserve an attitude of apparent indifference to her mate's advances.

Another unusual feature which distinguishes *Phalces* from other species is the presence of a thin greyish-blue cover either fitting tightly to the eggs or passed separately after the egg itself has been dropped by the female.

Book Notice.

Geschichte der Cecidologie. Ein Beitrag zu Entwicklungsgeschichte naturwissenschaftlicher Forschung und ein Führer durch die Cecidologie der Alten. Von Konrad Böhner mit einer Vorgeschichte zur Cecidologie der klassischen Schriftsteller von Felix von Öfele. 2 Teile. 4to. Mittenwald (Bayern) (Verlag A. Nemayer). Gesellschaft für Geschichte der Pharmazie. 1933, 1936.

These two volumes, issued by the Society for the History of Pharmacy, relate the history of Cecidology from the very earliest times.

The first volume is general in its character and contains the article by F. von Öfele on the pre-history of cecidology from classical sources of antiquity, followed by the detailed history of cecidology down to the present time.

Volume 2 is devoted especially to the Botanical and Entomological sides of Cecidology, but unfortunately the copy sent to the Society for notice is incomplete and wants that part dealing with Entomology.

THE UTILISATION OF FOOD BY THE LARVAE OF THE BUFF-TIP, *PHALERA BUCEPHALA* (LINN.) (LEPIDOPT.)

By A. C. Evans, F.R.E.S.

(*Department of Entomology, Rothamsted Experimental Station, Harpenden.*)

The following results have been obtained in a preliminary study of the nutrition of certain lepidopterous larvae to determine the reasons for their very different rates of growth on various host-plants. Several studies on the utilisation of food by lepidopterous larvae have already been published (Brown, 1930) and (Hiratsuka, 1920). The results obtained by these workers are somewhat vitiated by failure to allow fully for the errors liable to be involved in determining the amount of excreta derived from the food consumed and also by improvements in methods of chemical analysis. A few of the analytical methods used in the present study are not satisfactory, because it has not always been possible to use the best-known methods, since the amount of material available was limited.

Analytical Methods.

Food and excreta were preserved for analysis by drying at 100° C.

Non-protein nitrogen was extracted by grinding the material in a small amount of distilled water for 20 minutes, filtering on a Buchner funnel and washing several times with small quantities of distilled water. The amount of protein extracted in this way was quite negligible, acidification of the extract with trichloracetic acid produced a very faint opalescence, but no precipitate settled after standing for an hour.

The non-protein nitrogen was fractionated; ammonia and amid nitrogen were estimated by the methods described by Loomis and Shull (1937), and amino nitrogen by the method of Brown (1923). The difference between total non-protein nitrogen and the sum of ammonia, uric acid, amino and amid nitrogen is termed rest nitrogen. Uric acid was estimated by applying Hopkins' method (Cole, 1928), as follows: the excreta were cut into small pieces and shaken in 20 ml. of 0·025N-NaOH at room temperature for 10 minutes and filtered. The uric acid was precipitated by adding 3 drops of concentrated ammonia and enough ammonium chloride to saturate the solution. After standing for 2 hours the precipitate was filtered off and the estimation continued as described by Cole. No substance present in the food interfered with the estimation; an extract of food obtained in the above way was not oxidised by the permanganate.

Protein nitrogen in the extracted residues was estimated by the unmodified Kjeldahl method and total non-protein nitrogen by the reduced iron method.

Soluble sugars were extracted by boiling the material in 80% alcohol for 8 hours, filtering, and evaporating off the alcohol under reduced pressure at 35° C. The residue was diluted with distilled water, filtered and made to volume. The solution was prepared for the estimation of glucose, fructose and sucrose according to the methods of Van Plank (1936), the modification at room temperature for fructose being used. Sucrose was hydrolysed in 0·4% hydrochloric acid at 70° C. on a water-bath. The sugars were estimated by the method of Shaffer and Somogyi (1933). Dextrins were extracted by grinding the alcohol-extracted material in water for 20 minutes; after standing

for 40 minutes the extract was filtered and the material thoroughly washed. An aliquot was cleared with dibasic lead acetate and hydrolysed in 1+20HCl on a boiling water-bath for 3 hours, neutralised and the sugars estimated. No fructosan was found on analysing the extract according to the method described by Loomis and Shull (1937). Starch was extracted from the residues by the method of Hanes (1936). The extract was hydrolysed in 1+20HCl for 3 hours on a boiling water-bath. The starch extracted residues were hydrolysed in 1+20HCl for 3 hours on a boiling water-bath. The sugars present in the dextrin, starch and acid-hydrolysed residue extracts were estimated by the Shaffer–Somogyi method and reported as glucose. Cellulose was estimated by the method of Norman and Jenkins (1933).

Fat was extracted with ether in a Soxhlet apparatus. Soluble and insoluble ash were estimated according to A.O.A.C. methods (1930).

Biological Methods.

The accurate determination of the amount of excreta derived from a given amount of food would at first sight appear to be simple. In practice it was not found to be so in the case under consideration, owing to the continual loss in weight of food leaves and excreta due to evaporation and respiration during the experiment. These losses are not compensatory, the natural loss in weight of the food increases the amount of food apparently consumed, that of the excreta decreases the amount of excreta found, thus leading to a big error in the estimation of the amount of food utilised by the larva. These errors are minimised to some extent in the method described below.

In order to minimise loss of water from food and excreta the experiment was carried out in air-tight tins 6 inches in diameter and 6 inches in height. Hazel (*Corylus Avellana* L.) leaves were used as food for 60 larvae. A large number of comparable shoots bearing 7 leaves were cut, and divided into 3 groups which were placed in tins as follows :—

1. Control to determine natural loss in weight during the experiment.
2. Material for sampling at intervals to obtain a sample of food of average composition.
3. Actual food of larvae to obtain weight of food lost and amount of excreta produced.

The excreta were collected, weighed and dried every hour during the experiment. It was considered advisable to collect the excreta frequently, as data published by Brown (1930) show that a great increase of soluble carbohydrates occurs by the time the excreta is 24 hours old. In spite of this, however, he analysed excreta collected over a period of 24 hours. In order to keep conditions similar in all tins, the control food and sample food tins were opened and disturbed each hour. Since the weight of the food was not constant during the experiment, the natural loss in weight cannot be calculated on the initial amount of food present, it was therefore calculated on the mean between the initial and final weights. Table I shows the type of balance sheet obtained.

Table I.

The utilisation of fresh food by larvae of *Phalera*.

Weight of food lost . .	12·24 gm.	Weight of excreta obtained .	5·08 gm.
Natural loss (calc.) . .	2·69 gm.	Increase in weight of larvae .	3·26 gm.
Food consumed . . .	9·55 gm.	Total food accounted for .	8·34 gm.

Food unaccounted for 1·21 gm.

A certain amount of the food consumed cannot be accounted for, this amount is probably used, partly in respiration and partly in making good the water lost by evaporation during the experiment. Hiratsuka (1920) apparently makes the same assumption, judging from certain of his tables. Unfortunately he did not allow for the natural loss in weight of the food and so his figures for the amount of food used in metabolism are, in all probability, very inaccurate. The figures given in Table I show that had this correction not been made the amount of material estimated to be used in metabolism would have been 225% too much.

Two experiments were carried out and the material obtained from one analysed for nitrogenous substances and carbohydrates, and that from the other for fat and a check on the soluble carbohydrates. The material used for the analysis of ash was not obtained under the rigorous conditions described above and the results must only be regarded as very approximate.

Results.

The results shown in Table II are expressed on a basis of one gramme of fresh food, and show the amounts of the various substances present in that weight of food and in the excreta derived from it.

Table II.

Utilisation of the constituents of one gramme of food, in mg.

Substance	Food	Excreta	Change	% change
General				
Water	554	220	— 334	60
Dry matter	446	290	— 156	35
Nitrogenous substances				
Protein N	13·01	5·69	— 7·32	56
Rest N	0·50	0·26	— 0·24	48
Amid N	0·06	0·05	0·01	—
Amino N	0·05	0·08	0·03	—
Ammonia N	0·12	0·51	+ 0·39	382
Uric Acid N	0·00	0·49	+ 0·49	∝
Carbohydrates				
Fructose	30·4	9·0	— 21·4	70
Glucose	18·1	3·5	— 14·6	80
Sucrose	12·6	0·9	— 11·7	93
Dextrin	1·5	2·3	0·8	—
Starch	15·2	19·6	4·4	—
Acid-hydrolysable substances	18·2	16·5	1·7	—
Cellulose	46·4	44·4	2·0	—
Other substances				
Fat	13·4	5·0	— 8·4	63
Soluble Ash	24·3	18·5	— 5·8	24
Insoluble Ash	10·7	6·7	— 4·0	37

\+ sign indicates excretion.
— sign indicates absorption.
No sign indicates that the change is probably within the limits of experimental error or that it is not significant from the point of view of the larva.

Water is absorbed to a greater extent than dry matter both relatively and absolutely; this result might be expected since the food has a much higher percentage dry weight (approx. 44%) than the larva (approx. 20%). Protein is the most abundant nitrogenous substance in the food, about 60% is absorbed. Brown (1937) could not find any evidence for the presence of protein in the excreta of *Melanoplus bivittatus* (Say) fed on lettuce. A dilute Na_2CO_3 extract of the excreta of *Phalera* gives strong xanthoproteic and Adamkiewicz reactions. Nearly 50% of the rest N is absorbed. There are no significant changes in the amounts of amid N and amino N. In this respect *Phalera* seems to differ from *Melanoplus*, which, according to Brown (1937), possesses "an excretory mechanism that is deficient with respect to amino acid retention." Brown did not analyse the food of *Melanoplus*, so it cannot be decided yet whether his figures represent a change in amount or not. *Phalera* appears to excrete nitrogen chiefly as ammonia and uric acid. No attempt was made to determine whether creatine or creatinine were present.

TABLE III.

Comparison of the composition of excreta of *Melanoplus* and *Phalera*, mg. of excretory and total nitrogen per gm. of dried excreta.

	Melanoplus	*Phalera*
Total N . . .	42·4	23·4
Uric Acid N . . .	15·7	1·6
Ammonia N . . .	0·6	1·7
Amino N . . .	3·2	0·3

Table III shows that the distribution of certain excretory substances in the excreta of *Melanoplus* and *Phalera* differs very widely; especially interesting are the relative amounts of uric acid and ammonia.

McCay (1938) states that during its growth period the cockroach, *Blattella germanica* (L.), converts about 60% of the N of its food into tissue N. Working from the data given in Table II *Phalera* consumes 13·74 mg. of N in 1 gm. of food and excretes 7·08 mg., thus retaining about 49%, which is probably converted into tissue N. It retains about 87% of the N utilised. It is possible that not all of the uric acid and ammonia produced is excreted; some might be retained, in which case 87% is an over-estimate of the conversion. McCay (1938) puts forward the suggestion that the lower vertebrates are superior to the best of the higher vertebrates in the efficiency with which they convert foodstuffs into body tissues. The above results suggest that this hypothesis might be extended to include insects.

Of the carbohydrates estimated, it is probable that only fructose, glucose and sucrose are utilised and in that order in absolute amounts. However, the relative order in which they are utilised is the reverse. A check on this order was obtained by analysing the other batch of material; the results are shown in Table IV.

No evidence for the utilisation of polysaccharides was found. A slight increase in the amounts of dextrin and starch was found and a slight decrease in acid-hydrolysable substances and cellulose. These changes may possibly be due to autolytic changes in the plant tissue during and after its passage through the larval gut, a small part of the insoluble fractions being solublised.

" Cellulose " as estimated by Norman and Jenkins' method is not a pure substance but an aggregate of cellulose and cellulosans.

TABLE IV.

Utilisation of soluble sugars.

	Amount absorbed from 1 gramme of food	% Utilisation of each sugar
Sucrose . . .	7·5 mg.	93
Glucose . . .	15·1	83
Fructose . . .	19·7	68

About 60% of the ether soluble substances are absorbed. It is interesting to note that the amount of insoluble ash absorbed is nearly as great as that of soluble ash. A rough estimate of the percentage insoluble ash in the ash of the pupa was made. A value of 10% was obtained. This figure can only be regarded as approximate, as only 94 mg. of total ash was available for analysis.

The value 156 mg. for the change in quantity of dry matter does not quite represent the amount absorbed; a small correction should be made by adding 2 mg. to allow for the uric acid and ammonia excreted. If this correction be made it is necessary to account for 158 mg. of absorbed substances. Of these, 128 mg. or 80% can be accounted for as follows :—

Nitrogenous substances	58·2 mg.
Carbohydrates	47·7 mg.
Fat	8·4 mg.
Ash	11·8 mg.
Total	126·1 mg.

The weight of nitrogenous substances absorbed was calculated by assuming that they possessed a nitrogen content of 13%. This figure is based on some data given for the nitrogen content of leaf proteins by Chibnall (1933).

Some doubt has existed, in the case of phytophagous biting insects, as to whether food is extracted only from mechanically broken cells or whether the contents of the unbroken cells are utilised as well. Acqua (1916) held the former view, while Biedermann (1919) held the latter view, basing his conclusions on the microscopic examination of excreta. The results in Table II may be said to prove, in this case, that the contents of unbroken cells are absorbed, since a microscopical examination of pieces of food immediately after they have been bitten and also after they have been excreted show that the majority of the cells have not been broken, while over 50% of the protein, soluble sugars and fat have been absorbed.

SUMMARY.

An accurate method is described for determining in a caterpillar the amount of excreta derived from a given amount of food. Analysis of food and excreta show that about 60% of the protein, 80% of the soluble sugars, 60% of the fat and 35% of the ash are utilised. Polysaccharides are not utilised. Nitrogen is excreted as ammonia and uric acid.

References.

Acqua, C., 1916, Ricerche sperimentali sui processi digestivi della larva del Filugello. *Boll. Lab. Zool. Portici* **11** : 3–44.

A.O.A.C., 1930, *Official and Tentative Methods of Analysis.* 3rd ed. Washington.

Biedermann, W., 1919, Beiträge zur vergleichenden Physiologie der Verdauung. *Arch. ges. Physiol.* **174** : 392–425.

Brown, A. W. A., 1937, Studies on the excreta of a grasshopper (*Melanoplus bivittatus* Say). *J. exp. Biol.* **14** : 87–94.

Brown, F. M., 1930, The utilisation of hexose carbohydrates by lepidopterous larvae. *Ann. N.Y. Acad. Sci.* **32** : 221–230.

Brown, J. H., 1923, The formal titration of bacteriological media. *J. Bact.* **8** : 245–267.

Chibnall, A. C., Miller, E. J., Hall, D. H., and Westall, R. G., 1933, The proteins of grasses. II, A new method of preparation. *Biochem. J.* **27** : 1879–1884.

Cole, S. W., 1928, *Practical Physiological Chemistry.* 8th ed. Cambridge.

Hanes, C. S., 1936, Determination of starch in plant tissue, with particular reference to the apple fruit. *Biochem. J.* **30** : 168–175.

Hiratsuka, E., 1920, Researches on the nutrition of the silk-worm. *Bull. imp. seric. Exp. Sta.* **1** : 257–315.

Loomis, W. E., and Shull, C. A., 1937, *Methods in Plant Physiology.* 1st ed. New York.

McCay, C. M., 1938, The nutritional requirements of *Blattella germanica. Physiol. Zoöl.* **11** : 89–103.

Norman, A. G., and Jenkins, S. H., 1933, A new method for the determination of cellulose, based upon observations on the removal of lignin and other encrusting materials. *Biochem. J.* **27** : 818–831.

Shaffer, P. A., and Somogyi, M., 1933, Copper-iodometric reagents for sugar determination. *J. biol. Chem.* **100** : 695–713.

Van Plank, J. E., 1936, The estimation of sugars in the leaf of the Mangold (*Beta vulgaris*). *Biochem. J.* **30** : 457–483.

Book Notice.

Domestic Pests. What they are and how to remove them. By L. Hunter. London (Bale, Sons & Curnow), 1938. pp. xii + 235, 116 figs. Price 7*s.* 6*d.*

" This book is an attempt to help any housewife or mother to understand the why and wherefore of some very unwelcome guests which invade her home . . ."

It concerns itself with all varieties of pests from insects to rats and moulds, but the bulk of the book relates to insects. It is divided in two parts, the first relating to the harm done by the pests, methods of control and classification, and the special characteristics of animal and plant groups which are domestic pests.

The second part gives a brief description of each domestic pest and a simple remedy for the eradication of the pest and a list of references.

"SURVIVAL VALUE OF ACRIDIAN PROTECTIVE COLORATION"

Sir Edward Poulton said that he was anxious to call attention to a paper under the above title recently published [1] by Prof. F. B. Isely of Trinity University, Waxahachie, Texas. The experiments he describes were conducted during the years 1935–37, the methods being gradually improved and the results obtained in 1937 supplying the chief data recorded in the paper. A small part of his garden at Waxahachie was divided into 16 in. × 16 in. squares, of which 72, arranged in 6 rows, represented four different types of natural background, viz. black, white, and red soils—bare or with very sparse vegetation —and green, represented by a growing sod of Bermuda grass. The order of the colours was changed in each of the three groups of four which made a row. Two additional rows of 12 squares each were planted with tall vegetation. In the experiments "several different acridian species showing harmonizing coloration were employed," generally using young in the fourth or fifth instar. Two local white and two black species were available, but the two reddish-brown were sought at a distance of 35 miles, and the two green, although local, were difficult to secure.

The terms "protected" and "non-protected" were used to describe the harmonisation or contrast with background as determined by human sight-perception, and the object of the researches was to investigate experimentally the "sense-perception of *real enemies*, bird-predators, and their reactions, especially to cryptically colored acridians." In the experiments living insects were either anaesthetised by 3–5 min. in a cyanide jar (recovering after more than 20 min. in the open air), or picketed by means of a 3–4 in. light thread looped at one end on to a hind leg and at the other to a nail, thus tethering the insect to a selected square. The usual method was to choose matched pairs of each species, and place one of the two on a harmonising and the other on a contrasting square. The anaesthetised specimens, because of their complete immobility, represented natural conditions better than the picketed ones, but the latter were always used in the experiments with native birds because it was thought that the test would be considered more satisfactory. The author, however, came to the conclusion that the anaesthetised insects were in every way suitable, an opinion also held by his friends.

In *Experiment* 9, described as typical, 20 matched pairs of four Acridian species were disposed as follows: 9 white-phase specimens picketed on chalk-marl squares and marked P (protected), and 9 others on red, black or green squares and marked N (non-protected); similarly with 9 reddish-brown pairs, of which half harmonised and half contrasted with their squares, and finally with 1 pair of green and 1 of black. "Every effort was made to secure the best possible distribution of the 40 picketed specimens on the 72 squares of the checkerboard plot." Three bantams were released, allowed to hunt over the plot for two minutes and then taken off, with the result that of the 20 protected Acridians 10 had survived (5 white, 4 brown, 1 green); of the 20 non-protected 3 only. Eleven such experiments (Table I, p. 378) were conducted with bantams as predators, and 370 Acridians, of which seven species are mentioned. These were picketed in 6 experiments, anaesthetised in 5, and the final result was: *Non-protected*, 157 eaten, 28 survivors; *Protected*, 81 eaten, 104 survivors.

[1] 1938, *Ecology* **19**: 370–389.

Seven experiments (Table II, p. 379) were made with native birds as predators and 228 picketed Acridians of seven species. The birds mentioned are Sparrows, Mockers and Cardinals. The results were : *Non-protected*, 96 eaten, 18 survivors; *Protected*, 39 eaten, 75 survivors.

Seven experiments (Table III, p. 380) were conducted with turkeys as predators and 160 Acridians (six species) picketed in 3, anaesthetised in 4 experiments. Results : *Non-protected*, 73 eaten, 7 survivors; *Protected*, 37 eaten, 43 survivors.

The final totals of 33 experiments are recorded in Table V (p. 388), which includes 5 " Open cage " experiments with very striking results. The total number of 918 insects gave the following results : *Non-protected*, 405 eaten, 54 survivors; *Protected*, 183 eaten, 276 survivors.

An interesting contrast was provided by the behaviour of birds towards the gaudy grasshopper (Fig. 4, p. 385) *Dactylotum pictum* (Thos.), " mottled black, red, cream, yellow, green and brown," which was shown to be " the only inedible acridian out of some 40 species used at various times in these predator tests." After the first encounter the observers " were unable to develop the slightest interest on the part of the domesticated native birds in *Dactylotum pictum*." The author also calls attention to similar results obtained and conclusions reached by Dr. F. Morton Jones in his experiments [1] with the conspicuous " Lubber Grasshopper " *Romalea microptera* Beauv.

The author concludes from his most interesting and successful experiments : (1) that the " results clearly prove that cryptic coloration protects the acridian prey from bird predators," and (2) that " Acridian warning coloration appears indubitably to have survival value.

" Hence there can be no doubt as to the *natural selection value* of acridian protective coloration under bird predator pressure " (p. 388).

[1] 1934, *Trans. R. ent. Soc. Lond.* **82** : 447–449, pl. XVII. The reference on p. 389 of Prof. Isely's paper unfortunately quotes " Vol. **92** " and the Acridian is given the erroneous specific name " *mecoptera* " on p. 385.

Book Notice.

Warnen und Tarnen im Tierreich. Ein Bildbuch zur Schutzanpassungsfrage. Von Fritz Steiniger. (1938.) Berlin (H. Bermühler Verlag). pp. 91, 48 pls.

This is a book on warning and protective coloration in animals and it is illustrated by 91 photographs taken by the author.

The book is intended to take a place with the modern illustrated works on natural history. The text does not presume to be an exhaustive treatise on mimicry and its related phenomena, but, as is explained in the introduction, an attempt is made to give an impression of the whole picture of the subject by giving good illustrations of individual characteristics by special examples and observations from Nature and from the Laboratory. These illustrations are completed by the addition of observations of older observers, many of which were previously not available to German readers.

The author considers that the explanation of protective coloration is still to be proved and endeavours to give the views of all parties to the discussions which have taken place on the subject.

The work is written in a " popular manner," but scientifically presented.

HOUSE LIZARDS AND LARVAE

By D. G. Sevastopulo, F.R.E.S.

In a previous paper (1936, *Proc. R. ent. Soc. Lond.* (A) **11** : 91) I recorded the eating by a house lizard, or gecko, of the green, stinging larva of the Limacodid *Parasa lepida* (Cr.).

During the last year I have fed these lizards with various larvae and, although the number of species used is only small, the results seem worth recording as two species of typically aposematic larvae were eaten without hesitation.

These lizards live almost all their lives in houses, sleeping during the day behind pictures or in dark corners and becoming active at night. Their food, in the main, consists of insects attracted to the lights in the rooms they inhabit, and it is safe to assume that they never, in the natural way, come into contact with lepidopterous larvae. One may, therefore, consider that the lizard treats such larvae on their own merits and has no previous prejudices or inhibitions to overcome.

The method of feeding adopted was to attract a lizard on to the floor and then to throw the larvae close to it, until supplies were exhausted or the lizard sated.

The following species were employed :—

Polytela gloriosae (Fab.) (Noctuidae). A purple black larva with conspicuous white spots and a series of orange blotches at either end, about $1\frac{1}{2}$ inches long. A typically aposematic species that feeds gregariously, without any attempt at concealment, on Amaryllaceae and Liliaceae. Five larvae were offered to the same lizard in quick succession and were eaten without hesitation. There is a record (1936, *Proc. R. ent. Soc. Lond.* (A) **11** : 51) of the very similar larva of the closely allied *Brithys pancratii* (Cyr.) being refused by Guinea Fowl in Africa.

Chilasa clytia (L.) (Papilionidae). A jet black larva with a broad cream dorsal stripe from 1st to 9th somite, a broad cream lateral stripe from 1st to 6th somite, where it joins the dorsal stripe, and again from the 10th to 12th somite. A series of fleshy black spines subdorsally and a subdorsal, lateral and sublateral series of pink spots. Osmeterium blue and emitting a scent of, to me, rotting apples, to some people, very strong melon. About $1\frac{3}{4}$ inches long. Food-plant *Alseodaphne semicarpifolia* Nees (Laurineae). One larva, immediately it was offered, was seized by a small lizard and swallowed with difficulty owing to its size. The same lizard then ate a second and seemed completely sated.

Pericallia ricini (Fab.) (Arctiidae). Larva very similar in size and appearance to that of *Diacrisia lutea* (Hufn.) This particular specimen was feeding on sunflower. The larva was seized and killed by being beaten on the floor and wall, but it was not eaten.

Ocinara varians (Wlk.) Bombycidae). A brown mottled, thin larva about 1¼ inches long, feeding on *Ficus religiosa* Linn. Two larvae were eaten in quick succession.

Trabala vishnu (Lef.) (Lasiocampidae). 4th instar larva about 1½ inches long. Clothed with dense yellowish-white fur. A series of paired dull blue spots subdorsally. 1st somite with subdorsal pencils of long black hair. Head crimson marked with yellow. Food-plant Castor (*Ricinus communis* Linn.). Two lizards repeatedly sniffed the larvae and seemed to be repelled by the hair. In no case was a larva seized properly. An unknown Noctuid larva, of similar size and mottled brown in colour, was then offered and it was immediately eaten.

Whilst these results are based on too few specimens to allow of definite conclusions being drawn, it does seem that the mere possession of aposematic coloration is not a protection from the attacks of lizards. One might even be tempted to go further and state that, as it is likely that the larvae of *P. gloriosae* feeding on the same plants as the closely allied and similar *B. pancratii* will be equally unpalatable, lizards are deficient in their sense of taste and will accept insects that are refused by birds and possibly mammals. Hairiness appears to afford a certain measure of protection.

It is hoped to continue these experiments in the coming summer and, if possible, larvae of the Danaids *Danaus chrysippus* (L.), *D. limniace* (Cr.) and *Euploea core* (Cr.) will be included.

Book Notice.

Science in Africa. A review of scientific research relating to tropical and southern Africa. By E. B. Worthington. London, &c. (Humphrey Milford, Oxford University Press). Price 10*s.* 6*d.* pp. xv + 746, 8 pls., 5 maps (col.).

This book comprises 18 chapters, each of which is devoted to a subject such as "Zoology," "Fisheries," "Entomology" (Chapter X, pp. 257–300), "Agriculture" and so on. The 18 chapters occupy pages 1–613, the remaining pages of the book being concerned with the list of authorities "who have assisted by providing information or commenting on drafts," an extensive bibliography (pages 626–691) and an index (pages 692–746 in double column). The bibliography is arranged under the chapter headings.

The stated purpose of the volume is "to summarise the present position of studies in the various sciences which have a bearing on African conditions."

The chapter on entomology is stated to be based on "a special memorandum on insect pests other than locusts and tsetse flies" prepared under the direction of Dr. Neave of the Imperial Institute of Entomology.

For the information on locusts and tsetse flies the special work of the Imperial Institute of Entomology on locusts and that of the late Mr. C. F. M. Swynnerton on tsetse flies has been used as a basis.

The interrelation of entomology with other sciences is noted and references given to special cases dealt with in other chapters than that on Entomology.

SAFE ARRIVAL AND EMERGENCE IN ENGLAND OF FIVE PUPAE OF *PAPILIO DARDANUS* BROWN, SENT FROM NAIROBI BY CANON K. ST. AUBYN ROGERS

By Sir Edward Poulton, F.R.S.

A box containing the female parent of the form *lamborni* (*prototrophonius*), the pupae of five of her offspring and the letter of 4 July 1938, written by my friend Canon Rogers and quoted below, was delivered at Oxford by air-mail and reached our house on 12 July or perhaps on the following day.

" Ngong P.O., Nairobi.
" July 4, 1938.

" I am sending you in a small box five pupae of *P. dardanus* together with the female parent. I only had 9 pupae and one of them damaged itself in pupating and, as they did not feed up very regularly, the others are too early to send. I thought perhaps you might be interested to see the butterfly alive to which you have given so much of your time, and now that the mails go home so quickly there is some chance that they will reach you before they emerge. They sometimes remain in the pupal stage as little as 16 days but generally a few days longer and occasionally hang over for several weeks.

" I have recently sent home five families of *P. dardanus* to the B.M. and in case Mr. Ford may be interested I send particulars of the ♀ offspring on a separate sheet."

The female parent was labelled " Langata, Nairobi, 4.5.38." Concerning this locality my friend wrote :—

" Langata is the name I use for an extensive area of forest where I do much of my collecting. It is some five miles west of Nairobi and the elevation is about 5700 ft."

The pupae were taken to the Hope Department on 14 July and Prof. Hale Carpenter at once removed them to a warmer atmosphere in his house. On the morning of 21 July he found that the first butterfly, a *hippocoonides* ♀, had appeared and, as the wings were expanded and dry, emergence had probably taken place in the night or during the previous day when he was away from Oxford. The date of emergence was remarkably tactful, for the Entomological Club was meeting with Dr. Eltringham at Stroud on 21 July and the company had the great pleasure of watching the dignified movements of the first living imago of this classical species to be seen in England.

The five pupae produced the following female forms, all of which, with their pupal shells and the female parent, were exhibited to the meeting :—

1 *hippocoonides* emerged 20–21 July 1938.
2 *hippocoonides* emerged 4 or 5 August 1938.
1 *lamborni* (*prototrophonius*) emerged 7 August 1938.
1 *hippocoonides* emerged 14 August 1938.

To these must be added 2 *lamborni* and 2 males produced by the pupae retained by Canon Rogers, as recorded in his letter of 1 Oct., quoted below :—

" The pupae I retained emerged as follows :—

July 18—♂.
,, 22—♂.
,, 29—♀ *lamborni*.
Sept. 12—♀ *lamborni*.

3

"The *lamborni* of July 29 was from the damaged pupa and was a little crippled but able to fly though rather weakly.

"I have another small brood slowly emerging from a *hippocoonides* ♀ which so far has produced 3 *hippocoonides* and 4 *protosalaami*."

My friend Mr. E. B. Ford writes on these last-mentioned results :—

"It has already been shown [1] that there are good grounds for believing that the difference between *hippocoonides* and *protosalaami* is unifactorial, and that the latter behaves as a simple dominant. The male parent therefore appears to have been a heterozygote and the female a homozygous recessive. This would lead to segregation in equality which, approximately, is attained. It may, however, be observed that the numbers are too small to separate this from other possible ratios, were one to rely on the evidence which is at present available from this family. It resembles No. 90 in the above-mentioned paper, in which a *protosalaami* female produced 13 offspring, 6 being *protosalaami* and 7 *hippocoonides*, but differs in that the genetic constitution of the parents is reversed relative to their sex.

"In the family first described a female of the *prototrophonius* (*lamborni*) form produced 3 *prototrophonius* and 4 *hippocoonides* females. It is known that the difference between true *trophonius* and *hippocoonides* is unifactorial but it is not known which of them is dominant. There is evidence, furthermore, to show that *trophonius* and its more primitive stage *prototrophonius* are genetic modifications of the same gene, though this is not entirely conclusive. The present family suggests segregation in equality, on which basis one may presume one parent to be heterozygous and the other the homozygous recessive. It is indeed similar to No. 88 (Ford, *loc. cit.*) in which a *prototrophonius* female produced 6 *prototrophonius* and 5 *hippocoonides*. Thus these two families, while not inconsistent with previous deductions, throw no new light upon the genetics of *prototrophonius*."

In sending these notes Mr. Ford also wrote that a much smaller amount of work than that already devoted to the breeding of *dardanus* from captured females, "would have been sufficient to establish all the simpler aspects of the genetics of the species had it been conducted in accord with genetic requirements along the lines suggested for future research in my paper." These words bring home to us the fruitful results which may be hoped for by the method of transport which Canon Rogers has so successfully demonstrated—a method which may be confidently expected to bring an inexhaustible store of living and healthy material within the reach of our laboratories at home.

FRESHLY EMERGED *AGLAIS URTICAE* (LINN.), CAPTURED BY BIRDS WHILE OLDER SPECIMENS WERE NEGLECTED: A WHINCHAT PHOTOGRAPHED HOLDING A CAPTURED HESPERID BUTTERFLY

By Sir Edward Poulton, F.R.S.

My friend Mr. C. J. Grist wrote to me, 4 July 1938, describing an interesting difference in the behaviour of birds towards released butterflies—a difference which, I think, was more probably caused by a recognition of greater alertness

[1] Ford, E. B. (1936), *Trans. R. ent. Soc. Lond.* **85**: 435–66. For the names *protosalaami* and *prototrophonius* (*lamborni*) see p. 442.

and power of flight possessed by the more mature insects rather than by a preference for the taste of the freshly emerged, as suggested by the writer in the following passage. Further specially arranged observations would be of much interest.

" With reference to birds devouring butterflies, I remember some years ago a batch of small Tortoiseshells coming out of their pupa-cases in this house [Carol Green, Berkswell, nr. Coventry]. I allowed half-a-dozen to fly out of the window after a few hours when they seemed ready for flight and every one was at once taken by a bird although they appeared to be strong on the wing. I kept the rest of the batch, about half-a-dozen, indoors for a day or two and then let them fly out of the same window at about the same time in the morning, and not one of them was pursued by a bird. Perhaps this was because they are a more dainty morsel when fresh out of the chrysalis ? "

Mr. Grist has also directed my attention to an excellent plate [1] showing a hen Whinchat holding a captured " Skipper " in her beak. The figure had been reproduced from a photograph taken by Mr. J. H. Sears, of Rock, Yelverton, S. Devon. There was at first some difference of opinion as to the species of Hesperid represented in the plate—whether a male *Ochlodes venata* (Bremer & Grey) (*Augiades sylvanus* (Esp.)), or a female *Hesperia comma* (L.). Mr. Sears has kindly helped us to a safe conclusion in favour of the first-named, which corresponds with his own opinion at the time that the insect was not *comma*. Furthermore, the photograph was taken at 3.33 p.m. on 16 May 1937—much too early a date for this species. Confirmation was also afforded by an enlarged print kindly prepared by Mr. Sears from his negative (Selo Hypersensitive Panchromatic film pack) taken without screen. The examination of this enlargement together with the early date, convinced Mr. N. D. Riley, Mr. H. M. Edelsten, Mr. C. N. Hawkins and others that the species photographed was the " Large Skipper " (*O. venata*).

ABUNDANCE OF BIRD-LIFE AND EVIDENCE OF ATTACK ON BUTTERFLIES, IN JAVA.

Sir Edward Poulton drew attention to a passage in a letter, written 31 Oct. 1938, from Kuala Lumpur, F.M.S., by his friend Mr. H. W. Simmonds, referring to a month spent in Buitenzorg, Java, during which it became clear that this island would be a fruitful field for collecting material to extend in an important direction the great body of evidence which Prof. Hale Carpenter has accumulated at Oxford. He hoped that this fine opportunity would not be neglected.

" Last Sunday and the Sunday before we visited a small bush reserve about 20 miles from here, and it was interesting to see the very large number of butterflies having symmetrical pieces out of the hind-wings. I was also interested, when out with some collectors looking for *Scolia ruficeps*, to see a dragonfly stoop and capture a large *Terias*, and I saw another one with a *Plusia*. Bird life in Java is abundant and very beautiful, whilst in the early morning the song of birds is almost like England. It is now early wet season, with sunny mornings and heavy thunderstorms in the afternoons."

[1] *The Countryman*, **17**, No. 2 : 543, July–Sept. 1938.

WINGS OF BUTTERFLIES, DAY- AND NIGHT-FLYING MOTHS AND OTHER INSECTS COLLECTED BY THE LATE F. W. URICH IN THE HAUNTS OF A TRINIDAD BAT, *MICRONYCTERIS MEGALOTIS* (GRAY)

By Sir Edward Poulton, F.R.S.

My friend Dr. William Beebe of the New York Zoological Society, in a letter of 16 March 1936, wrote that he had recently been informed by Mr. F. W. Urich that he had *never* found any evidence of Heliconid butterflies having been attacked by this bat. I then wrote (30 March) to Mr. Urich and received the following reply :—

" 158 Charlotte Street,
Port of Spain,
Trinidad, B.W.I.
9.6.36.

" The experiments that Beebe wrote to you about concern the food of a small insect-eating bat *Micronycteris megalotis* (Gray). It consists of the bodies of certain butterflies and day-flying moths like *Castnia*. As it tears off the wings of butterflies it leaves evidence of its food under culverts and bridges. Although *Heliconius* and *Danais* are common in the district I have never found any of their wings.

" Through the kindness of Mr. C. H. Lankester I am sending you a box of wings which I collected on the East coast from the roosts of these bats. I shall be much obliged if you will let me have a list of the species. I shall keep up the collection and I shall be glad to have any instructions for further examination and collection. I am trying to domesticate these bats as I have done with others, but so far without success. I will continue the collection of wings."

As soon as the wings arrived, I wrote and suggested that it would be well to publish a list of names as soon as possible, at the same time asking for information about the habits of the bat.

Mr. Urich replied on 26 July 1936 :—

" I have your letter of the 3rd inst. I hasten to let you know that the bats are not day-flying at all but work at night, at least I have never seen any flying in the day. The Lepidoptera they capture are all day-fliers as far as I can make out. The *Castnia* are all day-flying moths. They are common because their foodplant, *Heliconia*, is common under the coconuts."

" *August* 7.—Your paper and letter of the 17th July have come to hand for which many thanks. I shall collect more data and photos and send you a regular paper for the Zoo. Proceedings later on, so kindly wait a bit. Besides *megalotis* I have notes and photos of *Vampyrus spectrum* that many travellers like Wallace refer to as harmless fruit-eaters, [but] are really fierce carnivors, including rats, opossums, and birds of various kinds in their diet. At present I have a ♀ in a cage which feeds on pigeons which she kills herself."

Concerning the habits of these bats Mr. T. C. S. Morrison-Scott, of the British Museum (Nat. Hist.), kindly gave me the following information in his letter of 30 Sept. 1938 :—

(1) *Micronycteris megalotis* (Gray). This bat usually flies only after dark —I have this from Sanborn of the Field Museum, who is an expert on bats. The possibility of the bats coming out before the day-flying Lepidoptera have ceased activity should by no means be ruled out, however, nor should the possibility of the bats taking the Lepidoptera off their resting-places be ruled out. Some British bats fly about in woods and collect insects off leaves (without themselves settling).

(2) *Vampyrus spectrum* (L.). There is an article by R. L. Ditmars (1935, *Bull. N.Y. zool. Soc.* **38** : 213–218), in which he describes a visit to Trinidad (he stayed with Mr. Urich) during which he inspected the roosts of this bat and found piles of feathers and rat-tails on the ground. Captive specimens " fed ravenously " on small birds and freshly-killed pigeons.

Both these bats belong to the Microchiroptera—Insectivorous Bats—and both belong also to the same subfamily, the PHYLLOSTOMINAE.

After Mr. Urich's death in July 1937 I felt that the collection of rejected wings should be described as soon as the work could be done, at the same time including any notes on the subject and a description of any specimens left in the Imperial College of Tropical Agriculture in Trinidad. The following letter, kindly written to me, 27 May 1938, by Mr. Alan Pickles, Entomologist, of the Imperial College, together with the absence of any further information, appears to lead to the unfortunate conclusion that nothing can be found :—

" I have received your letter of the 9th May, referring to the late Mr. Urich's studies on insectivorous bats. I was associated with Mr. Urich in his early work on this matter, but I regret to say that I am not acquainted with the later developments. Mr. Urich has left very little MS. and it probably will be difficult to find the information you seek. I am in touch, however, with Mr. Urich's former assistants and with Mrs. Urich and I will do my best to obtain the information in the course of the next ten days."

It only remains for me now to do as I had suggested to Mr. Urich in 1936 and describe the collection of wings received from him in that year. In naming the species from material, much of it in a very imperfect state, I received the kindest help from my friends in the British Museum (Nat. Hist.), also from my friend Dr. B. M. Hobby of the Hope Department, Oxford University Museum. The specimens are in two sections, one labelled December 1935 and the other March 1936, and it will be observed that the conclusions suggested by the earlier are very different from those yielded by the later.

I. The earlier specimens (Dec. 1935).

Rhopalocera.

HESPERIIDAE.—The only butterfly wings are those of Skippers belonging to the following three species : *Polites vibex praeceps* (Scud.), ♂, R.F.W.; *Urbanus* (*Eudamus*) *simplicius* (Stoll), R.F.W.; species doubtful but probably *Thracides* sp. nr. *longirostris* (Sepp), R.H.W.

Heterocera.

Moths of the following families provided the greatest number of wings :—

AGROTIDAE (formerly NOCTUIDAE), sp. ?, L.F.W.

NOCTUIDAE (CATOCALINAE), *Celiptera levina* (Cramer), R. and L.H.W.

NOCTUIDAE (OPHIDERINAE), *Athysamia incurva* (Sepp), L.H.W.

NOTODONTIDAE, *Dasylophia terrena* Schaus, ♂, R. and L.F.W., L.H.W.

Castniidae, *Castnia licoides insularis* Houlb., L.F.W.
Pyraustinae, *Liopasia rufalis* Hamps., 4 L.F.W's., 2 R.F.W's.

In addition to the Lepidoptera the only insects represented were Orthoptera of the following families :—

Orthoptera.

Gryllacrididae, *Gryllacris* sp., L.F.W.
Tettigoniidae, *Scudderia* sp.?, L.F.W.; *Scudderia* sp.?, R.F.W.; Genus?, L.F.W.; Genus?, R.H.W.
Phasmidae, Genus?, R. and L.H.W., perhaps of the same specimen.

This interesting collection appears to support the opinion expressed by Mr. Morrison-Scott (p. 38). The Hesperid butterflies have been often observed to fly late, and would also be readily taken at rest, as also the Orthoptera. Among the moths there is only one species known to fly by day, the *Castnia*, and this single specimen is insufficient evidence of capture on the wing. Certainly some and probably most of the remaining moths were taken during an evening or nocturnal flight.

II. The later specimens (Mar. 1936).

This little collection is very different from the earlier and leads to different conclusions, which it may be hoped will be confirmed by further observations. It consists almost entirely of Lepidoptera but includes only a single moth, the day-flying *Castnia licoides*, represented by fourteen wings, of which about half are nearly entire. The complete list is as follows :—

Rhopalocera.

Colaenis julia (Fab.).—R. and L.F.W., R. and L.H.W., perhaps of one insect.
Victorina steneles (L.).—1 R., 1 L.H.W., 4 R.H.W.'s, certainly representing 3, perhaps 4 specimens.
Anartia amathea (L.).—2 L.F.W.'s, ♂ and ? sex, 1 L.H.W., ♂, 2 R.H.W.'s, ♀, 5 R.H.W.'s, ♀, certainly representing 4 specimens.
Hesperiidae.—*Urbanus* (*Eudamus*) *proteus* (L.)—1 R.F.W.

Heterocera.

Castnia licoides insularis Houlb.—2 R., 3 L.F.W.'s; 4 R., 5 L.H.W.'s. The wings are unusually complete and certainly represent 5 specimens.

Odonata.

Libellulidae.—The two remaining wings are both Libellulinae, the R.F.W. of an unidentified species and the L.F.W. of another which may belong to the genus *Erythrodiplax*.

It is difficult to escape the conclusion that the specimens recorded above were in most instances taken by a day-flying enemy. The entire absence of moths except for a single diurnal species and the strong representation of this one as well as of two out of the four butterflies provide evidence which, combined with the absence of any trace of a night-flying insect, is too strong to be rejected except after renewed observations have been conducted on a much larger scale and at the same season. If confirmation be reached, the late Mr. Urich's statement on p. 38, that the wings of *Heliconius* are not to be found among this bat's rejecta, gains additional interest and significance, for these butterflies must be continually met by a day-flying enemy in Trinidad.

THE PARASITES OF *LUFFIA FERCHAULTELLA* (STEPHENS) (LEPIDOPTERA, PSYCHIDAE)

By Richard S. McDonogh, B.Sc., D.I.C.

Communicated by Dr. O. W. Richards, F.R.E.S.

Introduction.

During an investigation into the biology of the Psychid moth *Luffia ferchaultella* (Stephens) a number of records of the parasites of the species were obtained.

The list of parasites bred from the moth cannot be regarded as a complete one. An intensive collection of larvae from the south-west of England (excepting Cornwall and North Devon, where the moth does not occur) would almost certainly bring to light further species of parasites. It is only for the Thames basin and Essex that the parasite list can be considered typical.

Methods Used.

The collections of hosts were made as late in the life-history as possible, *i.e.* they were made in June and early July; the larvae were collected before pupation in some places but usually as spun-down cases. In 1935 all the cases from any one locality were kept in a tube, which was examined daily and any adults or parasites removed. In 1936 this procedure was varied in that each larval case was isolated in a gelatin capsule. All the capsules from one locality were kept on one shallow tray. By this means the parasitised cases could be preserved with the parasite. Both methods of keeping the pupae were unnatural and a larger proportion of the moths failed to emerge than in the normal habitat but the loss of parasites was very small, and the effect of parasitism on the species can be estimated easily by this method.

Acknowledgements.

The work was carried out at the Imperial College of Science and Technology Biological Field Station, Slough, Bucks, under the direction of Professor J. W. Munro.

I wish to thank Dr. O. W. Richards of the Imperial College for his kind interest and assistance during the course of my work. Also the following gentlemen who kindly identified the parasites: Mr. J. F. Perkins (Ichneumonidae), Mr. G. E. J. Nixon (Ceraphronidae) and Dr. H. F. Barnes (Cecidomyidae). The Braconids, Chalcidids and Hemiptera were identified by Dr. Richards.

Compared with many common Lepidoptera, *Luffia ferchaultella* cannot be considered highly parasitised. This may be due to the presence of the larval case which might be expected to afford a certain amount of protection.

Larvae collected from the Channel Isles in 1935 were parasitised to the extent of about 8·1%. The parasitism of English material varied in the two years during which it was studied. In 1935 a collection of 2960 larvae produced 99 parasitised cases, 3·34% of the late larval individuals. In 1936, 276 cases from a collection of 3990 larvae were parasitised, 6·92% of the late larvae.

Chalcidids were by far the commonest parasites of *Luffia*. Only two Chalcid species were very common, though six species were actually bred.

A fairly large proportion of the Ichneumonid parasites bred were species normally hyperparasitic. It is suggested that this may be due to the presence of the larval case which might supply the " double envelope " stimulus required by many hyperparasites during oviposition, and normally supplied by the presence of a primary parasite already inside the host. The effect of the larval case, surrounding the larva itself, might be to induce some hyperparasites to oviposit directly in the unparasitised moth larva.

The ratio of Chalcid/Ichneumon parasitism was 2·2 in both years.

An interesting feature was that only three specimens, belonging to two species, of Braconids were obtained from a collection of almost 7000 larvae. One specimen of a Proctotrupid was bred.

Though Tachinids have been regarded as fairly common parasites of Psychids, no dipterous parasites were obtained, with the possible exception of two specimens of a Cecidomyid.

The amount of parasitism varied considerably in different localities. 18% was the highest proportion noted.

The percentage parasitism of the larvae was not proportional to the population density of the host. Collections from a series of localities from Slough, Windsor, and Burnham Beeches gave a correlation coefficient between host-density and percentage parasitism of + 0·17 (P about 0·8). Similar counts for one species of Chalcidid on a line of trees in one locality showed almost no correlation, a coefficient of + 0·03 being obtained.

The peak of emergence of the parasites occurred about 7 days after the maximum period of emergence of the host.

During the first year the larvae used for breeding the parasites were kept together in tubes, only the larvae from different localities being separated from each other. This was unsatisfactory for several reasons; the case from which each parasite emerged was not known, and with the Chalcidids it was impossible to ascertain the number of individuals emerging from each parasitised case.

During the second year, however, when each case was isolated in a gelatin capsule immediately after collection, the case from which each parasite emerged could be preserved with the insect.

When the larvae were collected before they had pupated they were placed in a suitable cage until they had spun-down their cases. When this was done the pupae were transferred to the capsules. If there were only a few unpupated, the larvae were put straight into the capsules where the majority of them successfully spun-down and pupated.

13 species of 6 genera of Ichneumonidae were bred, 6 species of 6 genera of Chalcididae, 2 genera of Braconidae, and 1 species of Proctotrupid (Ceraphronidae) were obtained.

Ichneumonidae.

1 and 2. *Angitia.*

The two species of this genus form nearly half of the Ichneumonid parasites which were bred from *Luffia.* All the specimens except one bred during the summer of 1935 were one species called *A.* sp. b. The exception was obtained from Guernsey material and belonged to *A.* sp. a. In 1936 the genus was represented by *A.* sp. a, again with one exception, this time from Slough, Bucks, which was *A.* sp. b. The reason for this extraordinary change-over is unknown.

A. sp. a is larger than *A.* sp. b, and tends to have darker legs. There is also a difference in the sculpture on the propodeum of the two forms.

As a rule the parasitised larvae do not pupate. They spin-down their cases before dying. The dried-up larva is left in the case after the parasite has emerged.

A. sp. b is probably the same parasite as that recorded by Morley (1914: 197–8) as *A. tibialis* (Grav.) bred by Luff, Tutt and others from *Luffia lapidella* (L.) Mr. J. F. Perkins, however, considers it unsafe to name either of the two species positively.

Of *A.* sp. a, 31 males and 9 females were bred between 12th July and 24th August from Slough, and Burnham Beeches (Bucks), Nether Stowey (Somerset), Clyst Honiton (Devon), and Seend (Wilts). It was also bred from *L. lapidella* obtained in Guernsey, C.I.

Of *A.* sp. b, 7 males and 3 females were bred between 7th July and 24th July from Slough and Burnham Beeches (Bucks), Yateley (Hampshire), Capel (Suffolk), and Witham (Essex).

3. *Leptocryptus aereus* (Grav.) is probably a hyperparasite. Only one specimen was bred, a male from Epping (Essex), which emerged on 25th August.

4. *Trachyarus corvinus* Thomson is almost certainly a primary parasite. Two European species of the allied genus *Hemichneumon* are said to have been bred from PSYCHIDAE. 2 males and 1 female were bred from Slough (Bucks) and Theale and Hungerford (Berks).

5–9. *Hemiteles* spp.

This genus is represented by more species than *Angitia*, though in number of specimens bred it is about equal to that genus. The two genera together form the majority of the Ichneumons bred.

5. *H. areator* (Pz.) is almost invariably a parasite of Hymenoptera. It may be a hyperparasite when bred from *L. ferchaultella*, but examination of four cases from which it had emerged failed to provide any evidence for this.

5 males and 4 females were bred between 5th–26th August from Slough, Langley, Bourne End, and Burnham Beeches (Bucks).

6. *H. longicauda* Thomson is the commonest *Hemiteles*-species bred from *Luffia*. Adults were collected at Slough on tree-trunks 14–20 days before the first was bred from *Luffia*. Males are unknown.

24 females were bred between 8th July and 20th August from Slough, Fulmer, and Burnham Beeches (Bucks), Windsor and Wokingham (Berks), Epping and Orsett (Essex), Oxshott (Surrey), and Horsham (Sussex). The species was also obtained from material collected in Jersey, C.I.

7. *H.* sp. near *ornatulus* Thomson. This is probably Thomson's species but differs a little in colour from his description. In one instance, a larva of this parasite was found over-wintering in a case of *L. ferchaultella*. The case was collected in early July, 1935. The parasite larva was found fully grown in the case on 17th December. It remained in this state until the end of March, when it pupated. The adult female emerged 23rd May, 1936.

5 males and 4 females were bred between 13th July and 23rd July from Slough and Bourne End (Bucks), Henley (Oxon), and Waltham Cross (Essex). One specimen was obtained from Jersey, C.I.

Hemiteles (*Theroscopus*) sp. only a single female was bred from Clyst Honiton (Devon), emerging 24th July.

8. *Hemiteles* sp. This species has a red thorax and the distal half of the abdomen red; it may belong to a new genus allied to *Hemiteles*.

5 females were bred between 26th July and 10th August from Slough and Burnham Beeches (Bucks).

9–11. *Gelis* spp.

All the species are probably hyperparasites. Three species have been bred.

9. *G. corruptor* (Först.) (?). 3 females and 1 male were bred between 17th and 31st July from Slough and Burnham Beeches (Bucks), and Windsor (Berks).

10 and 11. *Gelis* spp. 1 and 2.

Both females bred were from Burnham Beeches material and emerged 9th–10th August.

12. *Pimpla examinator* (Fab.).

This is probably a primary parasite. One parasitised larva from Burnham spun-down its case on the 15th July and the parasite emerged on the 1st August. Its pupation time was therefore about 14 days. The other specimen from Petworth (Sussex) emerged on the 23rd July.

Braconidae.

13. *Apanteles* sp.

It is not yet possible to identify this species. 1 female and 1 male were bred from Bourne End (Bucks), and Wokingham (Berks). They emerged between 30th July and 5th August.

14. *Meteorus punctiventris* Ruthe. The single male specimen obtained was from Clyst Honiton (Devon). It emerged in late July.

Chalcidoidea.

15. *Eupelmus urozonus* Dalm. or sp. near. This specimen may be a new species. The normal form of *E. urozonus* bred from oak-galls always has a short ovipositor. The example from *Luffia* has a longer ovipositor. A large number of hosts have been reported for the typical *E. urozonus*. It has been recorded as both a hyperparasite and a primary parasite. My specimen was bred from Slough (Bucks) and emerged in late September.

16. *Eurytoma* sp. near *appendigaster* (L.). This is the commonest parasite of *L. ferchaultella* though it is closely rivalled in this respect by species 18.

E. appendigaster is known to be a parasite of *Apanteles*. It has been bred so commonly from *Luffia* that it is unlikely to be a hyperparasite of this moth. It is probable that the present species is a new one, but material bred from *Apanteles* is not available for comparison.

The emergence period in both years was 10th July to 10th August. Males were slightly predominant during the first half of the period, after which females outnumbered the males. The sex-ratio in 1935 was 14 males to 17 females, 1 : 1·2. In 1936 it was 1 : 2, 42 males and 85 females being bred. The insect attacks the host very sporadically. One or two trees from a group will be attacked, while the remaining trees are hardly affected. There does not appear to be any correlation between the percentage parasitism and the density of host population.

The species was bred from Burnham Beeches and Slough (Bucks), Horsham and Petworth (Sussex), and Harrow (Middlesex).

17. *Coelopisthus* sp. The cases of larvae parasitised by this species have a thin silvery lining inside the lichen-covered case. This lining appears to be

characteristic of *Coelopisthus*. When cases were isolated only single adults were bred from each parasitised larva. It is possible, however, that two or three may sometimes emerge from one case. It is almost certainly a hyperparasite and the silvery lining may be the last larval skin of the Hymenoptera host which originally parasitised the moth.

5 males and 10 females were bred from Slough (Bucks), Horsham and Petworth (Sussex). They emerged between 26th June and 27th July.

18. *Dibrachys cavus* (Walker). In point of numbers this is the commonest parasite of *Luffia* but the number of larval cases parasitised is less than for *Eurytoma*. Many of the specimens of *Dibrachys* were dissected to examine the mandibles. Both males and females had 4 teeth on each mandible. The teeth were blunter and less distinct in the males than in the females.

The species tends to emerge in batches with one- or two-day intervals, during which time few or none were obtained. This characteristic was particularly well marked in the males.

The number of individuals bred from one larval case varied. From English localities 5 was the maximum number. Both males and females were obtained from one case. Where both sexes occurred there was rarely more than one male. The usual number was 3 females and 1 male. Wholly male or female broods were quite common. Never more than 4 females were obtained from one case, though up to 5 males were bred from a single case. Cases from Guernsey, of *L. lapidella* which are larger than those of *L. ferchaultella*, produced up to 7 individuals.

The sex-ratio seems to be more constant than that of *Eurytoma*. In 1935, 23 males and 38 females were bred, giving a ratio of 1 : 1·6. The cases from Guernsey gave a ratio of 1 : 3, 10 males and 30 females being bred. In 1936, 63 males and 116 females gave a ratio of 1 : 1·8.

The species was bred from Burnham Beeches and Slough (Bucks), Epping (Essex), Harrow (Middlesex), Stonehenge (Wilts) and Wantage (Berks). Emergence period was from 7th July to 14th August. In 1935, no specimens emerged after 29th July.

19. *Elachertus* sp. is probably a primary parasite. Only 2 specimens were bred, a male and a female, both from Battle (Sussex). They emerged between 25th and 27th July.

20. *Elasmus flabellatus* Westw. This species is probably a primary parasite. One male and 2 females were bred from Yateley (Hampshire) and Theale (Berks).

Proctrupoidea (Ceraphronidae).

21. *Atritomellus* sp. near *flavipes* Kieff. The habits of this genus were not previously known. One female was bred from Slough (Bucks) and it emerged on 20th July.

In addition to the parasites the following insects were found amongst the material studied :—

Bethylus sp. nr. *fuscicornis* (Jur.) [1] (Bethylidae) was found in the breeding-cage soon after the Psychid larvae had been introduced. It may have been in the log of wood provided for the moth larvae to spin-down. The members of this genus are known to prey on Lepidopterous larvae.

[1] This species will later be described as new by Dr. Richards.

Two Anthocoridae (Hemiptera–Heteroptera) have been found inside the larval cases. The *Luffia* were dead, but there was no evidence to show that the bugs were responsible, though they are both known to be predacious. The species were *Temnostethus pusillus* (H.-S.), which was found among larval cases collected at Battle (Sussex) on 20th July, and *Microphysa elegantula* (Baer), which was very common in the cases during June and July. The females of this species occurred on the trees at Slough in large numbers. The males seemed to be more or less confined to the larval cases of *Luffia*. Only males were obtained from the cases.

Two cases of *L. ferchaultella* had apparently been attacked by a Cecidomyid. The specimens obtained have been assigned to the genus *Lestodiplosis*, but it is impossible to make a specific determination. The adults bred had transparent wings. Many of the species of *Lestodiplosis* are predacious on a variety of insects and usually each species keeps roughly to one kind, *e.g.* Aphids, red-spiders, etc., but it is unsafe to generalise. The old section of the genus, *Coprodiplosis*, has larvae which are considered to be coprophagous. This subgenus has adults with transparent wings, the predacious forms tending to have spotted wings. It is likely that the present species was living on the excreta of the moth larva, though it is not impossible for it to be a predatory form.

The pupa case of the fly was found attached to the *Luffia* case, and both the moth larvae had dried up. A male and a female were obtained, one from Seend (Wilts), and the other from Clyst Honiton (Devon). Both emerged late July.

Summary.

Luffia ferchaultella (Steph.) is not very highly parasitised, but 13 species of 6 genera of Ichneumonidae, 6 species from 6 genera of Chalcididae, 2 genera of Braconidae, and 1 species of Proctotrupid were bred during the two summers of 1935 and 1936.

A fairly large proportion of the species belonged to genera normally hyperparasitic, but it appears likely that they were not so in these cases.

Reference.

Morley, C., 1914, *Ichneumonologia Britannica*, London, **5** : 197–198.

Book Notice.

Tropenpracht und Urwaldnacht. Auf Tierfang am Amazonas. Von R. Rangnow. Braunschweig (F. Vieweg & Sohn) (1938). pp. 176, 26 pls. Price Rmk. 5.20 (less 25% to non-German purchasers).

This book gives an account, written in popular language, of the experience of the Ufa film expedition to the Amazons. The aim of the expedition was the making of a nature film in the virgin forests of the Amazons. Many photos of insects are included in the 65 illustrations. These are in part taken from the film made by the expedition.

ON THE OCCURRENCE OF THE MALE OF *NEMERITIS CANESCENS* (GRAV.) (ICHNEUMONIDAE, OPHIONINAE) IN BRITAIN

By W. H. Thorpe, M.A., Ph.D.

(*Department of Entomology, Zoological Laboratory, Cambridge.*)

I recently described (1938, *Proc. R. ent. Soc. Lond.* (A) **13** : 58–9) a case of mating between the males of *Angitia chrysosticta* (Gmel.) and females of *Nemeritis canescens* (Grav.). As was stated, at the time that that communication was written the only known males of this latter species were three recorded in 1931 and nine in 1937, all from Berlin.

It is therefore interesting to place on record that two males of this species appeared in one of my cultures on 31.i.1938. They were reared from a stock of the normal host *Ephestia kühniella* which had been kept at 25° C. They were immediately caged with females of the species, but although they displayed a slight tendency to follow the other sex, copulation was never observed. In this respect they resembled the three males recorded by E. Dautert Willimizik in 1931 (*Zool. Anz.* **93** : 274–5), rather than the sexually vigorous males described by A. Hase (1937, *Arb. morph. tax. Ent. Berlin-Dahlem*, **4** : 47–61). My two males fed normally on honey and water and were very active for about twelve days, after which they became moribund. One died on 14.ii.1938, and the other was then killed. The females with which they had been allowed to associate were provided with *Ephestia* larvae for oviposition, but only normal females resulted from their eggs.

As was mentioned in my previous note, many thousands of this insect have been reared in this laboratory during recent years, but with the exception of these two individuals only females have appeared. Apart from the lack of the ovipositor, the males in question appear practically identical with the females. A detailed description is not given as it is understood that Dr. Hase has such in preparation. I am greatly indebted to Mr. Perkins of the British Museum for confirming the identification for me. The specimens have been deposited in the British Museum.

Book Notice.

Agrion. Die Geschichte einer Libelle. Von W. Heinen. Berlin (H. Bermühler). pp. 154, 24 figs. Price Rmk. 3.00 (1938).

This book is a very readable account of the life history of a dragonfly. It is related in narrative for popular reading.

The book is illustrated by sketches of details from the life history.

A coloured dust jacket is from a painting by E. Schröder.

Book Notice.

Aquatic Insects. By J. Clegg. ("Water Life" Series 6.) London (Marshall Press). pp. 30, 28 figs. Price 6*d*. (n.d.)

This is a popular introduction to Insects suitable to or able to be kept in an Aquarium.

AN AMERICAN MEMBRACID IN JUGOSLAVIA (HEMIPTERA)

By B. P. Uvarov, D.Sc., F.R.E.S.

A collection of insects made by Mr. O. Grebenchikoff for the British Museum (Natural History) in the Balkan peninsula proved to include two adult specimens of *Ceresa bubalus* Fab., taken at Reznik near Belgrade, 28.xii.1938.

The genus *Ceresa* includes a number of species occurring in south, central and north America, and *C. bubalus* is well known there as an orchard pest. The date and the method of its introduction into Europe remains unknown, but it was first found in 1912 in the south of Hungary. Later it was recorded from a number of localities of southern France, while recently it has appeared as a pest in the Valais canton of Switzerland (Bovey and Leuzinger, 1938, *Bull. Soc. vaud. Sci. nat.* **60** : 193–200, where a complete bibliography may be found).

The occurrence of *C. bubalus* in Jugoslavia serves to fill the gap between the records from France and from Hungary and to confirm the suggestion made by Poisson (1937, *Bull. Soc. sci. Bretagne* **14** : 32–50) that the European distribution of this species is probably more extensive than is at present known.

OVIPOSITION BY *HETEROPTERYX DILATATUS* (PARKINSON 1798) (ORTH.–PHASMIDAE)

By N. C. E. Miller, F.R.E.S.

In view of the fact that it is commonly accepted that Phasmidae deposit their ova at random in the vicinity of their host plants, it is of interest to record that a female of *Heteropteryx dilatatus* (Parkinson 1798) found on a tree in jungle country at Kuala Sleh near Klang Gates, Selangor, Federated Malay States, deposited a considerable number of ova in the soil with which the floor of the cage, in which it had been placed, was covered.

These ova were placed at approximately 1½ inches below the surface of the soil and the entrance to the cavity was closed by loose soil falling in after the insect had withdrawn the apex of its abdomen. Oviposition took place at night : thus the manner in which the insect prepared the cavities in the soil and the time the operation occupied were not observed. Only one ovum was placed in each cavity. Feeding also took place at night.

The individual in question lived for 398 days in the laboratory, feeding on the leaves of Guava (*Pisidium guajava* L.) and during that period deposited 81 ova. Dissection of the ovaries, after the insect's death, revealed the presence of 52 ova.

Book Notice.

Outlines of Evolutionary Biology. By the late A. Dendy. Fourth Edition, re-issued with a foreword by M. Burton. pp. xlii + 481, 190 figs. London (Constable & Co.), 1938. Price 16*s.*

"Outlines of Evolutionary Biology is given here in precisely the form adopted by its author in the last [fourth] edition prepared shortly before his death in 1925."

The fourth edition was published in 1929 and the first in 1912. In addition to the four editions, the work has been reprinted seven times.

There are five parts to the work.

Part I. The structure and functions of organisms—the cell theory. Part II. The evolution of sex. Part III. Variation and Heredity. Part IV. The theory and evidence of organic evolution: Adaptation. Part V. Factors of organic evolution.

The index extends to 27 pages of double-column matter. There is a glossary of technical terms at the front of the book, filling 26 pages.

Book Notice.

Report on Agricultural Research in Great Britain. A survey of its scope, administrative structure and finance, and of the methods of making its results known to farmers, with proposals for future development. London (Political and Economic Planning, 16, Queen Anne's Gate, S.W.1). November 1938. pp. [vi] + 146, 1 map. Price 8*s.* 6*d.*

"P.E.P. (Political and Economic Planning) is an independent non-party group . . . who use . . . their special training in fact finding and in suggesting principles and possible advances . . ."

This report has taken more than three years in preparation and is the work of the Research Group of P.E.P. which is engaged in a survey of the use of organised science in the United Kingdom at the present time.

The chapters of the Report deal with the structure of agricultural research; the finance of agricultural research; the personnel of agricultural research; the spreading of scientific knowledge about agriculture; what is being done; agricultural research outside Great Britain; criticisms and conclusions.

A series of appendices give lists of Research Institutions, details of higher education, lists of Farm Institutes and Experimental Stations, details of expenditure on research in the civil estimates 1938, lists of staff of certain Research Institutions, particulars of grants to Colleges, etc., and details of Fishing and Forestry Research.

Criticism of existing methods and lack of research into and training for special branches of agriculture is made. Proposals are given for the improvement of the matters criticised.

Book Notice.

The microscope made easy. By A. L. Wells. 8vo. London (F. Warne & Co.). 1938. pp. 182, 12 pls., 20 figs. Price 3*s.* 6*d.*

This work is an elementary introduction to microscopy intended for beginners.

It opens with an "introduction to microscopy," giving details of a microscope for potential purchasers and rough notes on the broad principles of microscopy. Chapters are devoted to mounting materials and appliances, mounting methods, final preparation of slides, and various sources from which the microscopist may draw material.

BED-BUGS AND COCKROACHES

By C. G. Johnson and Kenneth Mellanby, F.R.E.S.

It is widely believed that cockroaches eat bed-bugs and that some measure of control of *Cimex* may thus be effected. The belief may have originated with Webster (1834) who stated that bugs entirely disappeared from a ship as soon as cockroaches made their appearance—" The fact is that the cockroach preys on them, and leaves no signs or vestige of where they have been." Newman (1855) wrote that " the fact is as old as the hills; it is that the cockroach seeks with diligence, and devours with great gusto, the common bed-bug." His evidence consisted of a reference to Webster and the testimony of a friend who, while living in an infested boarding-house " positively observed one of them seize a bug, and he therefore concluded, and not without some show of reason, that the cockroaches ascended the curtains with this special object, and that the minor and more odoriferous insect is a favourite food of the major one." Newman does not say that the bugs disappeared in the presence of roaches. A later record occurs in 1920 when Purdy stated that, in order to keep down the bed-bugs, it was necessary to reintroduce cockroaches into a house from which they had been exterminated. These three records are all we have encountered, except for others which cite these or give no authority.

From our observations, however, we are unable to show that *Cimex* can be controlled by *Blatta orientalis* or that bed-bugs are eaten to any great extent by them. Several experiments were made, with adult and nymphal bugs, and produced similar results; the two following examples are typical.

1. Fourteen adult females and nymphs of *Blatta orientalis* L. were confined at 23° C., without food, in a large Petri dish with forty adult *C. lectularius* L. (twenty dead, unfed and dried; twenty living bugs freshly fed on rabbit). The bugs were given a piece of perforated zinc on which to rest. After eleven days nineteen dead and eighteen living bugs were recovered; two dead bugs had been slightly gnawed by the roaches. Four had died from starvation and had been partially eaten by the live ones. The experiment was ended.

2. Two adult females and ten nymphs of *B. orientalis* were confined at 23° C. with twelve adult bed-bugs fed three days before on rabbit. All the bugs were recovered alive after a week and the experiment was discontinued.

The experiments were observed continually and cockroaches were never seen to eat nor to pursue a bug and they even died of starvation without feeding much on them; such starving roaches would eat bread with avidity, however, in the presence of bugs. One of us has studied a natural infestation of bed-bugs and cockroaches in an animal-house where both species occur together in considerable densities. The bugs do not seem to suffer attack and their numbers have increased greatly over a period of a few weeks (room temp. = 20° to 27° C.).

Thus bugs may be eaten by cockroaches, but it is unlikely that they could control them. In the case mentioned by Purdy the fluctuations of bed-bugs probably had no relation to presence or absence of cockroaches.

References.

Webster, W. H. B. (1834). *Narrative of . . . H.M.S. Chanticleer*, 1 : 373,
Newman, E. (1855). A word for the Cockroach. *Trans. ent. Soc. Lond.* (n.s.) 3 : 77.
Purdy, J. S., 1920, The control of insect vectors of disease in war and peace. *Aust. med. Congr.* (*Trans. 11th Session*) : 299.